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Wage and Productivity Gaps

Evidence from Ghana

Dorte Verner

Ghana's labor market is segmented, and the workforce adds more to firm-level productivity than its cost would suggest. The more training and education workers have, the higher their wages and the greater their productivity. In short, investments in human capital improve productivity.

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Summary findings

Verner uses a unique data set (combining information about individual workers with information about the firms employing them) to jointly estimate production functions and wage equations. This approach allows her not only to assess the marginal impact on wages of demographic and other characteristics but also to compare how these variables affect productivity among various groups of workers. Among her findings:

- Female employees are paid less than male employees, but this negative wage premium does not reflect commensurately lower productivity.
- Employees' experience is reflected equally in wages and in productivity differentials over the worker's life cycle. Wages and productivity both increase, but at a decreasing rate.
- The more training and education workers have, the higher their wages and the greater their productivity.
- Productivity differences can be demonstrated for five levels of education completed. The productivity gap is greater than the wage gap.
- Returns to education are similar across gender, sectors, and level of unionization, but they are lower for unskilled workers than for skilled workers.
- Training supplied by outside providers (as opposed to in-house training) is associated with higher wages but appears to have no (immediate) impact on productivity.
- Trade union members' wages are in line with productivity. Both wages and productivity are higher for union members than for non-union members.

This paper — a product of Human Development 3, Africa Technical Families —is part of a larger effort in the region to understand how labor markets work in Africa. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Hazel Vargas, room I8-138, telephone 202-473-7871, fax 202-522-2119, Internet address hvargas@worldbank.org. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/html/dec/Publications/Workpapers/home.html. The author may be contacted at dverner@worldbank.org. August 1999. (49 pages)

Wage and Productivity Gaps: Evidence from Ghana

Dorte Verner

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1. Introduction

This paper studies labor market outcomes in Ghana. The analysis focuses on the formal manufacturing wage sector and, more specifically, on the determinants of wages and productivity for various groups of workers. It tests hypotheses that relate to the impacts of individual and enterprise characteristics on wages. Furthermore, it compares the marginal impact of each of these characteristics on wages with their respective impact on labor productivity. The results may indicate whether, for example, there exists a spot labor market, discrimination, and/or structural differences among sectors and groups of workers.

The paper analyzes whether experience, training, and education impact wages and productivity. In recent years, analysts have paid a lot of attention to the impacts of education and labor force training. The rationale for investing in human capital is that a more skilled and educated labor force is more productive than a less educated one. Therefore, policymakers emphasize investment in human capital because they believe that, in general, it increases labor productivity. However, there is not have much evidence of this relationship in the Africa region.[1]

This paper aims partially at filling this void by presenting evidence on the direct impact of education, training, and experience on productivity for different groups of workers using econometric regression analyses. It looks at whether Ghanaian labor markets are characterized by gender discrimination. It analyzes whether the labor markets

[1] Glewwe (1996) finds that there is no return to human capital in Ghana.

are competitive. And it looks at whether union membership, manufacturing sector, and firm location affect labor market outcomes.

I use data from the 1994 Regional Program on Enterprise Development (RPED) survey on Ghana, which covers 215 manufacturing enterprises ranging from micro enterprises to very large enterprises. The questionnaire used in the data collection process has two related parts: one for management and one for workers. In addition, about 10 randomly selected workers from different occupational categories were interviewed in each enterprise. The RPED dataset matches employee and employer data and contains detailed information on both. The two types of information are merged from individual data on skills, education, and age, and from firm-level information about sector, production, sales, and employment.

Empirical studies of the determinants of wages and earnings inequality have focused primarily on factors affecting labor supply. Long-run labor supply factors include variables such as education, age, gender, and experience.[2] Few studies have used variables controlled by the employers, the so-called demand factors. One reason is that in most industrial and developing countries more information has been collected on workers than on their employers.

The lack of data on worker productivity constrains empirical research related to issues of wage determination. For example, without direct measures of productivity,

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[2] Groshen (1991a) mentions that education, age, occupation, ethnicity, gender, and union variables account for only 51 percent of the variation in the log of wages, analyzing (US) data from the Current Population Survey One Quarter Earnings Sample, 1986. Introducing demand-related factors is likely to explain part of the 49 percent of the variation in wages that workers' characteristics cannot explain.

discrimination by gender or ethnicity cannot be established correctly. Many studies of wage determination report positive coefficient estimates on the age of an employee, conditional on a variety of covariates. These estimates neither imply that older workers are more productive than younger ones, nor that wages rise faster with productivity because no bridge has been made between productivity and wages (see Hellerstein, Neumark, and Troshe 1996). These problems may be overcome by estimating the wage and productivity equations jointly and, thus, comparing wages and productivity for various groups of workers.

Section two describes the methodology and data used in this study. Section three outlines the wage determination model used. Section four shows descriptive statistics and presents regression results. Section five presents conclusions.

2. Data and Methodology

I carry out this study with the so-called RPED dataset from the 1994 survey in Ghana. The survey included 215 firms and interviewed about 1,200 of their employees. This matched employee-employer dataset has many advantages compared with datasets of just employees. An employee dataset may contain information about the sector in which a worker is employed but little information about the firm. An employer dataset has information about the firms but limited information about the individuals actually employed in the firms, apart from aggregate wage costs and, in some cases, information

about aggregate education and training costs. The employer-employee dataset allows detailed analyses of hypotheses related to both firms and individuals.

Unfortunately, many of the variables in the 1994 round of the Ghana RPED dataset have very few observations. This is the case, for example, for the share of exports in output, expenditures on research and development, and foreign licenses. Hence, these variables are excluded, so that the regression analysis includes relatively few enterprise-level controls.

I use the so-called general-to-specific econometric methodology in the regression analysis. I apply this methodology by formulating a general model and then reducing it to a parsimonious specification by eliminating statistically insignificant variables one by one, while focusing mainly on the determination of wages. The more parsimonious specification includes only statistically significant variables in the wage equation.

The general wage model contains explanatory variables in levels and some are also included in quadratic form, hence allowing for nonlinearities in the data. The natural log wage equation or the production function may be quadratic in variables such as experience. This way of modeling may capture that the return to experience is not constant but rather decreasing over the life cycle. Additionally, I introduce dummy variables that take the value of one if, for example, the worker is a member of a trade union and zero otherwise. Inclusion of this variable may reveal whether there is a wage or productivity premium related to union membership.

I use simultaneous single-level statistical models. These models may cause aggregation biases equivalent to problems produced in the learning achievement literature. In this literature, workers are the units of observation and firms are included in

the individual vector of variables. It is worth noting that, in general, this methodology may cause aggregation biases in two ways. First, it may overestimate the group effect, that is, the firm effect, on productivity. Second, it may underestimate the individual effect on wages and productivity. Multi-level estimation takes aggregation biases into account.

The firm-level effect impacts average production and the individual slope of, for example, gender. And the gender effect may be different in different firms. Furthermore, the group level effect may not be the same for every single worker. However, the hierarchical linear modeling software does not allow for missing observations. Additionally, small firms have too few employees to actually perform the multi-level analysis. Due to these data limitations, I report only the results obtained by estimating single-level models.

3. Modeling Wages

Competing models of wage determination depend on the connections among wages, productivity, and employee-employer characteristics. Standard wage determination analyses (single-equation wage models) consider employee characteristics in the process of determining wages, but make no link to productivity. Standard analyses rarely consider employer characteristics. I analyze wages, productivity, and employee-employer characteristics simultaneously. Without direct measures of the relative productivities of employees, discrimination by gender, for example, cannot be based only on statistically

significant estimated coefficients on the respective dummy variables in the individual-level wage regression.

Standard single-equation wage regressions report positive coefficients on age conditional on a variety of covariates. These regressions do not imply that wages increase faster than productivity or that older employees are more productive than younger ones. Therefore, it is important to analyze productivity and wage determination simultaneously.

The regression analyses describe monthly wages and productivity in the formal manufacturing sector, conditional on individual and firm characteristics. The following equation explains the wage and productivity:

$$\ln y = \sum I\beta + \sum F\delta.$$

The dependent variable (y) is a vector containing two variables: wages (w) and productivity (v), thus enabling a richer analysis than when applying the standard single-equation wage determination model. The vector of explanatory variables in the analyses consists of firm/employer characteristics (**F**), the so-called demand factors, and employee characteristics (**I**), the supply factors. When y is reduced to scalar w, the traditional wage determination model appears. β and δ are vectors of parameters revealing the marginal impacts of the explanatory variables on wages and productivity.

The production function is estimated in a value-added form for two reasons. First, the input variables, such as materials, may be endogenous. By applying this specification, the analysis does not need to estimate the coefficients on materials. Second, this specification embeds contrasting production function specifications. For example, in

one specification, the elasticity of substitution is zero, so that materials have to be used in fixed proportions. In another specification, the elasticity of substitution is infinite (see Grilliches and Ringstad 1971).

There are several reasons for including various worker characteristics. A trained and educated workforce provides flexibility in adapting to changes in technology or other economic changes that a firm and an economy may face. Experience and years of schooling are widely used in analyses of wage determination and inequality (see Welch 1969 and Mincer 1974).[3] The wage bargaining literature has emphasized institutions such as trade unions as an important factor in the process of determining wages. Gender and ethnicity variables reveal information on the female-male wage gap and wage differentials associated with different nationalities. If discrimination exists, it may be indicated by these variables having significant parameters. Including the sector of employment enables testing competitive economic theories, some of which predict that the sector of employment has no impact on earnings differences for similar workers. And the location of an enterprise may be important because, for example, life in cities is generally more expensive than in towns. Workers may be compensated for the higher cost of living. Section three discusses each group in more detail.

I estimate the wage equation and the value-added equation jointly by regressing them on the same independent variables. The estimated individual coefficients and standard errors produced by multivariate regression are identical to those that would be produced by estimating each equation separately. The difference is that, because

[3] See Levey and Murnane (1992).

multivariate regression is a joint estimator, it also estimates the between-equation covariances. Therefore, coefficients can be tested across equations to reveal whether costs are in line with productivity.

The analysis assumes that employees with different characteristics are perfect substitutes in the production process, but with potentially different productivities. The individual-level wage and production equations are estimated simultaneously, allowing for comparison of the average productivities and wages of employees distinguished by various characteristics. This empirical setting may reveal new information on selected issues related to the determination of wages in Ghana. For example, it may provide evidence about gender discrimination in wages and the causes of increasing remuneration over the life cycle.

When equality of the parameter estimates of a particular variable in the two equations cannot be rejected statistically, I interpret this result as evidence compatible with the existence of competitive spot labor markets. Rejection of equality of the parameter estimates points toward noncompetitive labor markets or discrimination. The analysis allows productivity to vary by type of employee and by type of enterprise by adding controls for enterprise characteristics, such as sector and region.[4]

[4] There are numerous studies of the Ghanaian labor market. Canagarajah and Thomas (1997) analyze returns to education. Jones (1994) studies wages and productivity of workers in the manufacturing sector. Teal (1995) investigates whether the decline in real wages reflects the existence of a competitive labor market in Ghana. Velenchik (1995) focuses on apprenticeships in the manufacturing sector. Teal (1996) analyzes the possible existence of economic rents within the manufacturing sector.

4. Determinants of Wages and Productivity

Appendix table A-1 lists the variables and describes the construction of each variable. Appendix tables B-1 through B-4 present the results of joint estimation of the wage equations and production functions, controlling for both firm and employee characteristics. The variables that cannot be rejected as statistically insignificant are eliminated one by one from the general model and the final selected wage model is presented in the tables in appendix B.

4.1 Differentials by Formal Education

Human capital has proven important in enhancing long-term economic growth.[5] A more educated workforce is likely to increase worker productivity, show innovative behavior, and facilitate the adoption and use of new technologies. The increasing speed of technological change that firms face today and increasing international economic integration call for workers to have higher skill levels in order for firms to be competitive. One reason is that more skilled employees can adjust more easily to changes in the economic and technological environment than less skilled workers.

Knowledge about economic returns to human capital gives insights about the extent to which it is worth undertaking this particular investment compared with other types of investment. Therefore, it is of interest to estimate the impact on money wages of different kinds of education, training, and other experience. This analysis may indicate

areas where scarcity in training and education may exist because the existence of a wage differential due to training may be interpreted as rent (to skilled labor).

Education in Ghana. The system of education in Ghana consists of up to 17 years of pre-university education: six years of primary school, followed by four years of middle school and seven years of secondary school. After pre-university education, higher education includes professional, polytechnic, or university education.[6]

Table 1. Education by Gender and Residence in Ghana (percent)

	Gender		Residence	
Educational level completed	Female	Male	Accra	Other
None	15.1	8.0	5.4	15.9
Primary school	1.6	3.8	2.9	4.3
Middle school	31.4	48.9	46.5	48.8
Secondary school	18.4	12.4	14.7	9.2
Vocational school	23.8	11.4	13.6	15.2
Professional and technical schools	8.7	14.3	15.2	6.1
University	1.1	1.3	1.8	0.6
Total Percent	100	100	100	100

Note: The values show the percentage of each category of workers with each level of education. For example, 15.1 percent of the females in the sample have not completed any level of education.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

[5] See Barro (1991) and Mankiw, Romer, and Weil (1992).

[6] In 1987, the education sector was reformed and pre-tertiary education was reduced to a total of 12 years.

The distribution of education from the RPED data across gender and geographical regions reveals that in the formal manufacturing sector, the majority of workers have completed middle or secondary education (see tables 1 and 2). The data contain three notable features. First, middle school is the most common level of completed education (46 percent). Second, almost twice as many employed females as males have not completed any education.[7] Third, fewer of the workers employed in Accra (9 percent) have completed less than secondary education, compared with workers employed elsewhere in Ghana.

Table 2 presents the percentage of workers in each sector that has completed each level of education. Most notably, the share of workers with no or primary education is quite small in the metal sector (6 percent) compared with the average share across all across sectors (13 percent). University graduates make up the largest share in the food sector (3 percent).

Table 2. Education by Manufacturing Sector (percent)

Educational level completed	Total Manufacturing	Manufacturing Sector			
		Metal	Textile	Food	Wood
None	9.3	3.7	10.0	16.6	7.8
Primary school	3.3	2.0	3.8	3.9	3.5
Middle school	45.8	50.8	46.7	35.5	58.3
Secondary school	13.5	12.6	13.8	15.4	8.7
Vocational school	13.6	15.0	10.7	13.5	13.0
Professional and technical schools	13.3	15.6	13.9	12.0	7.9
University	1.3	0.3	1.0	3.1	0.9
Total Percent	100	100	100	100	100

[7] Note that only 17.9 percent of the sampled workers are women and less than 0.5 percent are non-Africans.

Note: The values show the percentage of each category of workers with each level of education. For example, 9.3 percent of all manufacturing workers in the sample have not completed any level of education.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

Impact on wages. The estimated coefficients on the education variables in the wage equation reveal the impact of human capital obtained from education on wages controlling for other individual and firm characteristics (see appendix table B-1).[8] The impact on wages of each of the six categories of completed education (primary, middle, secondary, vocational, technical, and university) is statistically significantly different from zero (no education completed being the category of reference). This result indicates that the more education a worker has completed, the higher wage the worker receives, conditional on a variety of individual and enterprise covariates, including occupation. The estimates show that the size of the wage premium to education increases rapidly with completed level of education.

The wage gap is 51 percent for workers who completed primary education, compared with those who did not complete any level of education. An employee who has completed middle school obtains a wage premium of 41 percent. The wage gap is 56 percent for secondary graduates and 186 percent for university graduates. These results are in line with those of Canagarajah and Thomas (1997), who find that workers in Ghana who have completed tertiary education earned 2.7 times more than illiterate workers in 1991.

[8] The results reported in the text are exponential transformed estimates reported in appendix B

Hence, formal education has an impact on manufacturing wages, but it is not monotonically increasing. In fact, the analysis cannot reject the hypothesis that the estimated coefficients for primary, middle, and secondary education are of equal size (F(pri=sec)=0.04, Prob>F=0.83; F(sec=mid)=1.54, Prob>F=0.22; F(mid=pri)=0.16, Prob>F=0.69; and F(sec=voc)=2.84, Prob>F=0.09). Wage analyses of industrial countries usually find that the incremental returns to education fall as the level of schooling rises. However, the above results indicate that the returns do not fall in Ghana for the formal manufacturing sector. An employee who has completed technical or vocational education also receives a statistically significant premium in addition to that already captured by occupational controls and experience. The wage premiums are 48 percent and 20 percent, respectively (see appendix table B-1).

These results indicate that education has spillover effects on productivity, meaning that education's aggregate contribution to output may be larger than its costs. The endogenous growth literature has emphasized these spillover effects or positive externalities that result from increasing returns to scale in the production function due to educational or learning externalities (see Lucas 1988). The spillover effects of education may result from entrepreneurial ability to speed up the adaptation of technology throughout the market.

Impact on productivity. The regression results show that education enhances firm-level productivity in Ghana. The country's manufacturing sector has a positive and marginally significant production differential by completed education above primary level. Primary education does not contribute to productivity because it does not have a

statistically significant impact on value added. The quality of primary education may be low or not sufficiently high so as to benefit value added in firms. This result may indicate that there is a private return to obtaining a diploma, which serves as a screening device when hiring labor. Workers who have completed middle school education contribute on average 372 percent more to value added than workers with no completed schooling. University and secondary school graduates contribute 660 percent and 287 percent, respectively. Furthermore, technically trained workers and employees who have completed vocational training provide 185 percent and 127 percent, respectively, more to value added than do workers with no completed education (see appendix table B-1).

Wages and productivity. The wage differentials by education fall behind productivity differentials by education and significantly so for completed middle and secondary education. The test rejects the hypothesis of equality of the wage and productivity differentials. For completed middle and secondary school, the test rejects the hypothesis that the workers are paid according to their productivity in both cases ($F=14.2$, $Prob > F=0.00$; $F=6.24$, $Prob > F=0.01$). Hence, the positive wage gap between workers with completed secondary education and no completed education can be completely justified by higher productivity. Furthermore, workers with completed secondary education could demand higher wages so as to match productivity. This result also holds for completed middle school education.

Several reasons may explain why the workers do not demand higher wages. They may not be aware of the magnitude of the impact completed education has on productivity. Workers may not be aware of the extent and importance of knowledge

spillovers in the manufacturing sector. In addition, in Ghana, educated people have been loosing jobs in the last five to ten years. Thus, demanding higher wages may lead to more job insecurity. The findings may not indicate a shortage of educated employees or a lack of demand because these results would be out of line with the standard assumption that wages reflect the productivity of labor. Another explanation may be that knowledge spillover effects, which are not instantaneously reflected in pay, indicate that social returns in a firm are higher than private returns.

The cost of a university graduate seems to be in line with firms' benefits because the results do not reveal any discrepancy between productivity and returns to education. The test for equal coefficients in the wage equation and production function cannot be rejected at conventional levels of significance ($F=1.39$, $Prob > F=0.34$). However, the small number of university graduates in the sample may affect the results. Another explanation may be that this group of workers obtains higher enumerations than revealed by wages. Also, earnings may include fringe benefits that often are large in the manufacturing sectors in Africa.

For both completed vocational and technical education, wages are not in line with productivity ($F=4.48$, $Prob > F=0.04$; and $F=4.72$, $Prob > F=0.03$). Productivity exceeds wages in both cases, implying that workers with completed vocational and technical education are under-compensated as compared with their productivity.

When substituting the individual school attainment variables with a continuous variable for completed education, the other explanatory variables' impacts on wages are unchanged. There exists a significantly positive return to holding a permanent contract, but the impact on value added is insignificantly different from zero. The completed

education variable is statistically significantly different from zero. The education premium obtained from completing an additional level of education is 15 percent, conditional on a variety of individual and enterprise covariates (see appendix table B-2). The effect on productivity is statistically significant and the size of the impact is 54 percent.

Education has a less pronounced influence on wages than it has on productivity, except for completed primary education. This result is illustrated by the significance and larger coefficient estimate of formal education in the productivity equation than in the wage equation. Therefore, researchers should be careful in interpreting the traditional earnings function approach as a means of estimating the effects of, for example, education on productivity. Policymakers often use results from earnings function estimation to make decisions about public expenditures. The findings here indicate that wages are not always a good proxy for the physical product. They suggest that enterprises in Ghana do not always "get prices right," that is, wages do not equal productivity.

4.2 Differentials by Occupation and Skill

Table 3 shows some differences in the occupations of employees due to gender. More women than men work in administrative activities and more men than women hold managerial positions. The table also shows that more than half of both male and female

employees work in production. Only professionals and commercial workers each account for less than 10 percent of the total sample.

Table 3. Gender and Occupation (percent)

Occupation	Full sample	Female	Male
Administration	11.8	25.4	8.8
Commercial	6.7	7.6	6.5
Manager	10.0	5.4	11.0
Production	54.9	54.1	55.1
Professional	3.5	1.6	3.9
Support	13.2	6.0	14.7
Total Percent	100	100	100

Note: The values show the percentage of each category of workers with each level of education. For example, 25.4 percent of all female manufacturing workers in the sample work in administration.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

Table 3 divides the employees into six groups by occupation: manager (encompassing managers, supervisors, and foremen); administration (administrative workers and clerks); commercial (commercial workers, salespeople, maintenance workers, and technicians); support (support staff); production (production workers); and professional (engineers, accountants, and others). The regression analysis reveals that only the impact of managers is statistically significant and positive in the wage equation, controlling for other individual and firm characteristics. The reference group for the analysis is workers in maintenance, skilled production workers, other production workers, support staff, and trainees. The calculated occupational wage premium is 33 percent for managers and -40 percent for support staff (see appendix table B-1). Surprisingly, the estimated productivity of managers is not statistically significantly different from that of

the reference group. Productivity differentials by occupation do not fall behind wage differentials, as revealed by the rejection of all tests of equality between the two estimates (F(jobsupp)=2.67, Prob > F=0.10 and F(jobman)=0.01, Prob > F=0.93).

I use the occupational data to test for the possibility of a gap in returns between skilled and unskilled labor in Ghana. Skilled workers are those in the manager, administration, and professional, occupations. Unskilled workers are those in the commercial, production, and support occupations. The skilled employees may receive higher returns to experience, sector, training, education, unionization, occupation, and location than unskilled employees. The results are based on the inclusion of interaction variables in the analyses. A dummy variable that takes the value one if the employee is unskilled is interacted with the variables presented in appendix table B-1.

The findings indicate that the returns to education and, in particular, to having completed middle and secondary education, are lower for unskilled than skilled workers (see appendix table B-4). The comparison group is workers who have not completed any level of education. The unskilled workers who have completed middle school earn returns 23 percentage points lower than skilled workers do(see appendix table B-4). The productivity analysis reveals that unskilled workers are not statistically less productive than skilled workers. The economic return to completed secondary education is 24 percentage points lower for unskilled than for skilled workers.

4.3 Differentials by Trade Unions

Twenty-nine percent of the employees in the sample belong to trade unions. The data show that female workers are not less unionized than male workers. In contrast, the data show an education-unionization gap; workers who have completed university education and those with just primary education fall below the average level of unionization (see table 4).

Table 4. Union Membership and Education (percent)

			Total	
Educational level completed	Union	Non-union	Percent	Number
Full sample				
Percent	28.7	71.3	100	
None	23.2	76.8	100	
Primary school	14.7	85.3	100	
Middle school	27.4	72.6	100	
Secondary school	28.1	71.9	100	
Vocational school	37.9	62.1	100	
Professional and technical schools	34.3	65.7	100	
University	0.0	100.0	100	

Note: The values show the percentage of each category of workers with each level of education. For example, 14.7 percent of the manufacturing workers in the sample who have completed primary school belong to unions.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

Table 5. Union Membership and Occupation (percent)

			Total	
Occupation	Union	Non-union	Percent	Number
Full sample				
Percent	28.7	71.3	100	
Administration	40.2	59.8	100	
Commercial	33.3	66.7	100	
Manager	26.2	73.8	100	
Production	24.1	75.9	100	
Professional	16.7	83.3	100	
Support	40.4	59.6	100	

Note: The values show the percentage of each category of workers with each level of education. For example, 40.2 percent of the manufacturing workers in the sample who work in administration belong to unions.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

Workers in administration and support occupations have the highest share of workers in unions; workers in manager and professional occupations have the lowest share (see table 5). It appears that unionization makes a difference in wages because the union premium in the Ghanaian manufacturing sector is statistically significant and positive (see appendix table B-1). Union members earn more than nonunion members do, when controlling for firm and individual characteristics in the wage equation.

In addition, union members have statistically significantly higher productivity than nonmembers do. The test of the hypothesis that the wage and productivity gaps are of equal size is highly rejected ($F=68.44$, Prob > $F=0.00$). The estimated wage differential associated with being a union member is approximately 16 percent (see appendix table B-1). This outcome is in line with results found for industrial countries, which usually reveal that union members earn more than nonunion members. These results may provide evidence that trade unions do not reduce wage differentials and, therefore, that unions negatively affect the distribution of income.

The finding for Ghana may be surprising because other African studies of the impact of unions on wages report a negative association. Both results for CFA countries applying a cross-section dataset of African countries (Rama 1997) and results from wage analyses in Zimbabwe (Verner 1998) show that trade unions impact wages negatively. The presence of trade unions is generally associated with more firm-provided training. Trade union bargaining at the firm level may increase social welfare by counterbalancing

a firm's monopsonistic power in wage determination (see, for example, Booth and Chatterji 1997).[9]

4.4 Differentials by Employer-Led Training

In industrial countries, governments have increasingly emphasized the importance of employer-led training. The benefit of training should be in the form of higher output. Training provides workers with the skills necessary for improving competitiveness, adaptability, and growth. Furthermore, skill acquisition may reduce wage inequalities.

In addition to informal on-the-job training by supervisors and co-workers, employers may supply formal training, either in-house or by outside providers. The incidence of training in the Ghanaian manufacturing sector is relatively high compared with industrial and semi-industrial countries. Around 64 percent of the employees receive formal structured training. In the sample, 28 percent of the workers received in-house training (see table 6). This value is in line with the data for Taiwan, where 38 percent of large firms and 4 percent of small firms train employees in-house (see Tan and Batra 1995). Furthermore, 36 percent of the Ghanaian employees received training outside the firm.

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[9] Booth and Chatterji (1997) show that long-term contracts are socially optimal when workers are trained because the training reduces workers' incentives to quit and leave with the skills obtained. Alternatively, wage bargaining by firms and local unions may ensure that the post-training wage is set sufficiently high to defer inefficient quits, and thus to ensure that the number of trainees the firm takes on is near the socially optimal number. Hence, it would be expected that the results here would show higher post-training wages.

Table 6. Gender, Residence, and Training (percent)

		Gender		Residence	
Training	Full sample	Female	Male	Accra	Other
In-house	28.0	33.0	27.0	25.1	34.2
By outside providers	36.2	24.7	38.7	38.0	35.4
None	35.8	42.3	34.3	36.9	30.4
Total Percent	100	100	100	100	100

Note: The values show the percentage of each category of workers with each level of education. For example, 28.0 percent of the manufacturing workers in the sample received in-house training.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

The incidence of training is only marginally higher for firms in Accra, compared with firms outside the capital (see table 6). Fewer female employees receive training outside the firm and more receive training inside the firm than male workers do. Forty-two percent of the female workers are not trained, compared with only 34 percent of the male workers. Investigating sector differences in the incidence of training reveals that the wood sector trains relatively fewer workers than the other sectors. Only 24 percent of all employees do not receive any training, while 32-37 percent of workers in the wood sector do not receive training . More support staff receive training than workers in other occupations do.

Table 7. Occupation and Training (percent)

Training	Administration	Commercial	Professional	Production	Support	Manager	Full sample
In-house	11.6	14.7	8.6	35.7	29.6	20.4	28.0

By outside providers	47.9	29.4	45.7	30.5	44.4	42.7	36.2
None	40.5	55.9	45.7	33.8	26.0	36.9	35.8
Total Percent	100	100	100	100	100	100	100

Note: The values show the percentage of each category of workers with each level of education. For example, 11.6 percent of the manufacturing workers in the sample who work in administration received in-house training.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

Only 26 percent of support staff do not receive any training, compared with the average of 35.8 percent across all occupations (see table 7). Employees in commercial and sales occupations receive the least training; 55.9 percent of this group does not receive any kind of training (table 7). University graduates receive the most training, 76.9 percent (see table 8).

Table 8. Education and Training (percent)

Training	Educational level completed							Full sample
	None	Primary school	Middle school	Secondary school	Vocational school	Professional and technical schools	University	
In-house	30.9	23.5	24.8	37.9	13.4	14.7	0	28.0
By outside providers	35.1	41.2	30.7	32.7	40.3	44.9	76.9	36.2
None	24.0	35.3	44.5	29.4	46.3	40.4	23.1	35.8
Total Percent	100	100	100	100	100	100	100	100

Note: The values show the percentage of each category of workers with each level of education. For example, 30.9 percent of the manufacturing workers in the sample with no completed level of education received in-house training.
Source: Round Three of the 1994 Regional Program on Enterprise Development for Ghana.

In-house training. The hypothesis that training has no impact on wages is not rejected for training within the enterprise. This result indicates that in-house training does not directly contribute to measurable wages. In addition, formal training obtained within the firm is not significantly more productive than the training workers obtain from colleagues in an informal way. The results hint that in-house training is not productive; however, it seems more likely that the impact is not instantaneously revealed in wages and productivity. Initially, there is no measurable effect of in-house training in the data, but effects may be measurable at a later date.

Training by outside providers. The analysis rejects the hypothesis that training supplied by outside providers has no impact on wages. Workers who have undergone formal, structured training outside the firm earn 16 percent more than workers who have not been trained (see appendix table B-1). However, the regression results indicate that training is not associated with higher firm-level productivity. In terms of the level of

parameter estimates and in a statistical sense, the productivity-enhancing effects of training are not important for training obtained outside or inside the firm.

The productivity effects of skilled worker training are estimated to be not significantly different from zero. This result is surprising because studies of other low-income countries have found a statistically significant impact. For example, Tan and Batra (1996) find significant coefficients of 1.43 for Indonesia and 0.39 for Columbia. Verner (1998) finds a statistically significant coefficient estimate of 0.33 for Zimbabwe. I find that training by outside providers is not associated with increased productivity in Ghana, possibly because the impact of training is not instantaneously reflected in productivity.

Underinvestment in training. From the regression analysis, it appears that Ghana underinvests in training. Evidence of underinvestment is suggested by significant returns to outside training, reflecting its relative scarcity. Training activities generate skills and knowledge that are employee specific in the sense that the employee may quit and take the accumulated human capital away from the firm. This possibility makes trained employees more valuable to the firm than other workers, including workers from other firms.

Acemoglu and Pischle (1997) show what happens when the current employer has superior information about the worker's ability relative to other firms. This information advantage gives the employer an ex post monopsony power over the worker, which encourages the firm to provide training. Acemoglu and Pischle's model can lead to multiple equilibria. In one equilibrium, quits are endogenously high; as a result,

employers have limited monopsony power and are willing to supply little training. In another equilibrium, quits are low and training is high. It would seem to be valid to apply this model in the African context, where job mobility and the number of quits are low in the formal sector.

Firms in Ghana provide little or no training for several reasons. The country has imperfect capital markets, limited access to information, and other market failures. The results for employer-led training seem to imply that policies that encourage increased enterprise training will lead to larger productivity gains for the economy as a whole. However, the results here show that in-house training does not pay off in terms of higher wages. It may be that the effect is not captured by the available data. The failure of training to increase productivity would cause a disincentive to invest in training. The policy implication is presumably that Ghana should promote training by outside providers.

4.5 Differentials by Experience

Labor market experience is not easy to measure. However, the labor market literature has used the age of an employee as a proxy. The worker's age is included in the wage equation both in levels and squared to allow for possible nonlinearities. Both age variables are statistically significantly different from zero and have the expected signs (see appendix table B-1). Experience affects wages positively and the relationship is nonlinear, controlling for other individual and enterprise characteristics. More

experienced workers have higher levels of labor productivity; the productivity curve is steeper at the early stage of a worker's life than later. Put differently, the estimated life cycle wage profile in Ghana has the usual quadratic shape known also from industrial countries. The positive effect of experience on wages is increasing for younger workers and continues for older workers at a decreasing rate.

The productivity profile in the Ghanaian manufacturing sector follows the pattern of wages; it increases at a decreasing rate over the life cycle. However, the wage gap and the productivity gap are not equal in size ($F=4.41$, Prob > $F=0.04$; $F=1.42$; Prob > $F=0.22$). These results indicate that the increase in productivity obtained from a more experienced workforce is larger than the costs.

4.6 Differentials by Apprenticeship

Apprenticeships are widespread in labor markets in Sub-Saharan Africa (see Velenchik 1995). In Ghana, 10.2 percent of the sampled workers have been apprentices in the firm in which they currently work. Moreover, the share of apprentices does not seem to differ significantly across gender. The trainees often pay for their training in Ghana. The economic rationale is that an apprenticeship raises future productivity and thereby increases future earnings by more than the current fees.

The results of the empirical analysis show that employees who have been apprentices do not obtain higher wages than others do. The analysis detects no positive return to apprenticeships, controlling for formal education and other individual and firm

characteristics (see appendix table B-1). The point estimate of the wage differential is -0.31 and the wage gap is significantly different from zero, controlling for individual and firm characteristics. For the value-added specification, the estimate of the productivity differential is negative but statistically insignificant. Hence, the negative wage premium is out of line with productivity.

4.7 Differentials by Gender

Empirical research on gender pay gaps has traditionally focused on the role of gender-specific factors, particularly gender differences in qualifications and differences in the treatment of otherwise equally qualified male and female workers (that is, labor market discrimination).[10] This section explores the determinants of the gender pay gap and argues

[10] Modern explanations of the gender wage gap rest on two pillars: the human capital interpretation and models of labor market discrimination. The human capital explanation was developed by Mincer and Polachek (1974) and others. This idea is based on productivity differences between men and women and, therefore, differences occur in economic outcomes in the form of pay and occupation. The human capital model builds on the traditional division of labor in the family. According to this theory, women have fewer incentives to invest in human capital than men because women anticipate fewer work weeks over their life span than men. The result is that women have lower human capital investment than men do and consequently women have lower wages. The same arguments are thought to cause gender differences in occupation, as females choose occupations where human capital investment is less relevant and penalties for spells of labor force interruptions are smaller. Models of labor market discrimination builds on work originating from studies on ethnic discrimination. For example, Becker (1957) conceptualized discrimination as taste or personal prejudice against a specific subset of a larger group. A related type of model is the so-called overcrowding model (see Bergmann 1974). It builds on exclusion of a group, for example, women, from "male" occupations and, therefore, leads to excess supply of workers in "women's" occupations. Despite equally productive workers, the excess supply suppresses wages in "women's" occupations.

for the importance of an additional factor in the analysis, namely productivity. Furthermore, it takes into account the possible difference in prices set for labor market skills and the rewards received for employment in favored sectors.

In empirical research on the evidence of discrimination, traditional single-equation models rely on the existence of a residual gender pay gap that cannot be explained by gender differences in measured qualifications. This is seen to accord well with the definition of labor market discrimination, that is, wage gaps between groups that are not explained by productivity differences, see Blau 1996. Blau notes that pay differences between groups may also reflect group differences in unmeasured qualifications or compensating differentials. If men are more highly endowed with respect to these omitted variables, then discrimination would be overestimated. However, if some of the controls (for example, occupation) themselves reflect the impact of discrimination, labor market discrimination will be underestimated.

The analysis here reduces these caveats by comparing estimated differences in wages and productivity and controlling for the same measure of qualifications in both equations. Under perfect competition in the capital and labor markets, equivalent employees at equivalent jobs are compensated equally, that is, there is no discrimination. The analysis concludes that labor force discrimination exists in Ghana only if both the following hypotheses are rejected: (1) the impact on wages and productivity of being a woman is zero; and (2) the estimated impacts on wages and productivity are of equal size.

Female workers comprise about 17 percent of the interviewed workers in the sample. The regression analyses reveal that, on average, females are paid statistically

significantly less than male workers, controlling for differences in qualifications and individual and other characteristics. The wage gap between men and women is notable at a general level in the Ghanaian manufacturing sector. Women are paid 17 percent less than men (see appendix table B-1). It seems dubious that this result occurs because women are less productive than men, taking into account segregation by gender across labor market sectors and the level of qualifications such as education and experience. The analysis controls for sector of occupation, so that it takes into account the possibility of larger rents received by workers in favored sectors, implying that it would be harder to detect possible discrimination.

The point estimate of the productivity differential is found to be statistically different from zero and negative. Female workers are 37 percent less productive than male workers, accounting for qualifications, occupation, and sector of occupation. Does that mean that there is gender discrimination in the Ghanaian manufacturing sector? Both the wage and productivity gaps are significant and the former is lower than the latter. The analysis tests whether the coefficients are statistically the same in the two equations and rejects the hypothesis of equality ($F=1.08$, $Prob > F=0.30$). This result is not consistent with parts of the wage gap being attributable to discrimination against women. In fact, the results indicate that women receive more compensation in terms of wages than their male colleagues. Further analysis shows that the lower wages that Ghanaian women earn do not seem to originate from being employed in the textile sector. The results show that women working in textiles do not earn less than their male colleagues, controlling for the textile sector and other covariates.

The analysis looks at whether the wage structure is important in the determination of wages for men and women in Ghana. I test the hypotheses that some sectors have larger returns to skills, all else equal, leading to a larger gender gap; these hypotheses are all rejected. I also consider the possibility that women may receive lower returns to experience, sector, training, education, unionization, occupation, and location than their male colleagues. The outcome indicates that there are no gender differences in returns to the four levels of formal education or technical education, unionization, or occupation. The analysis yields statistically insignificant parameter estimates of interaction variables of the female dummy variable with each of the explanatory variables. However, the results indicate that women receive lower returns to experience than men (around 1 percentage point). The results hint that increased female experience impacts productivity less than increased male experience (see appendix table B-3). The results across sectors show that women are paid more than men in the wood sector (142 percent), despite not being significantly more productive.

The analysis now considers the possibility of a gap in returns between male and female labor in Ghana. I analyze whether male employees receive higher returns to experience, sector, training, education, unionization, occupation, and location than do female employees. The education premium is neither larger for males than for females nor does there exist any particular sector premium related to education. The Analysis, including education variables for both males and females, shows that females do not obtain a significantly lower return than do men in any of the six levels of education. Surprisingly, the gender-wage differentials by level of education are not very strong and,

4.10 Differentials by Contract

There are good economic reasons why, in many circumstances, it is in the interests of both the employer and the employee to form a long-run employment relationship, thereby helping to build and retain firm-specific skills. The estimated wage differential associated with permanent employment in a firm is estimated to be statistically insignificant. Hence, there does not seem to be a trade-off between enhanced job security and wages. The contrary view that job security endows insider workers with more bargaining power that makes it possible to achieve higher wages does not seem to hold in Ghana. The result that greater job security seems not to lead to lower wages suggests that insider workers benefit from trade unions.

The productivity differential associated with a permanent contract is positive but not statistically significantly different from zero. Moreover, temporary workers are not less productive than permanent workers, indicating that the former may be working hard in an attempt to obtain a permanent contract.

4.11 Differentials by Marriage or Ethnicity

The marriage premium is not statistically significantly different from zero. This finding is surprising because results from wage analyses in industrial countries usually show that married workers earn higher wages than unmarried workers. This finding reflects that

married workers are more productive—whether because of selection or a true productivity effect—or that firms discriminate in favor of married workers. No good theoretical argument explains why married workers should be paid more. However, the Ghanaian manufacturing sector data show that married workers are more productive than unmarried workers, even though the difference is not revealed in earnings.

I could not analyze whether differentials by ethnicity exist in manufacturing in Ghana because too few Europeans or other ethnic groups were interviewed (less than 0.5 percent of the interviewed workers are non-African).

5. Conclusion

I used a unique dataset from Ghana that combines data on individual workers with data on workers' employers to estimate plant-level production functions and wage equations. I compared relative productivities and relative wages for various groups of workers and jointly estimated wages and output functions. This approach allows not only for assessing the marginal impact of demographic or other characteristics on wages, but also comparisons of the impact of these variables on productivity.

The analysis found that wage differentials match productivity differentials for certain groups of workers, while for others they do not. Female employees are generally paid less than male employees and the negative wage premium females receive does not match the corresponding negative productivity premium. Females' returns to schooling and training are not different from those of males.

Employees' experience, as measured by age, is reflected equally in wages and productivity differentials over the life cycle. Both wages and productivity increase, but at a decreasing rate. However, the impact of experience on productivity is significantly higher than on wages. These results indicate that the increase in productivity obtained from a more experienced workforce is larger than the costs. However, other compensations may not be reflected in wages, and these may be distributed unequally across the life cycle, for example, allowances for children's education.

In the formal manufacturing sector, the majority of workers have completed middle or secondary education. The size of the wage premium to education increases rapidly with completed level of education and with occupation. The size of the positive returns to education for primary, secondary, and middle school are not statistically significantly different. Furthermore, the analysis reveals productivity differences for five levels of completed education: middle; secondary; vocational; technical; and university. Primary education does not contribute to increased productivity. University graduates are worth the high returns and, in fact, the productivity differential is in line with the wage premium. This is not the case for middle, secondary, technical, and vocational education, where the productivity gap is significantly larger than the wage gap. Hence, the positive wage gap between workers with completed middle, secondary, vocational, technical, or university education and workers with no completed primary education can be justified because the former groups are also more productive than the latter.

For workers in management, the analysis establishes productivity and wage differentials that are in line with economic theory. The analyses show that returns to education are not different across gender, unionization, or sector. However, they are

lower for unskilled than skilled workers and the former are not less productive. Furthermore, returns to experience are lower for women than for men. The results suggest that the educational curriculum above the primary level in Ghana is providing workers with productive skills. The study suggests that wages are not always a good measure of productivity for public expenditure decisions.

The incidence of training in the Ghanaian manufacturing sector is relatively high compared with industrial and semi-industrial countries. The incentive for investing in training is that it leads to higher output. The results reveal the existence of an asymmetry in training: training supplied by outside providers is associated with higher wages, while there does not seem to be any (instantaneous) effect on productivity. In-house training does not have a productivity enhancing effect and it is not instantaneously rewarded in the form of higher wages. Therefore, a scarcity of trained workers may exist to some degree. The results show that policies encouraging increased training and education will lead to larger productivity gains for the economy.

Apprentices obtain a negative wage premium, but they are neither more nor less productive than their colleagues who have not been apprentices. Workers employed in an enterprise located in Accra are both more productive and paid higher wages than workers in other locations. Furthermore, the productivity differential is significantly larger than the wage differential.

Employees in the wood sector are paid lower wages than employees in the textiles, metal, and food sectors. Employees in the wood sector are less productive than employees in other sectors. However, the impacts on wages and productivity are of equal magnitude.

Long-term contracts do not help firms to retain and build firm-specific skills. The analysis does not indicate that there is a trade-off between enhanced job security and wages or that job security endows insider bargaining power. The trend in manufacturing employment has been increasing slowly since 1982, which further strengthens this result. However, the productivity differential associated with a permanent contract is not different from zero, indicating that neither temporary nor permanent workers lack the incentive to work hard. Temporary workers are just as productive as permanent workers. And trade union members' wages are in line with productivity. Wages and productivity for union members are higher than for nonunion members.

Altogether, the results indicate that the labor market in Ghana is not perfectly competitive, but segmented. For example, wages are not equal for workers with similar skills employed in different sectors. Thus, the analysis finds structural differences across sectors.

The analysis compared coefficients on education from the production function with coefficients from the wage function. It showed that firms behave competitively and pay workers with completed university education according to their productivity. However, for all other levels of education, firms do not behave competitively; they pay either more or less than workers' productivity. The former category encompasses primary education and the latter middle and secondary education.

The results obtained in this paper indicate that the workforce employed in the manufacturing sector in Ghana adds more to firm-level productivity than the costs it involves. Thus, wages are out of line with productivity, possibly due to externalities or spillover effects, for example, in skills. Hence, the level of wages is not too high to

compete internationally. Furthermore, the analysis provides evidence that increased human capital, through training or education, as it benefits both productivity and wages. Economic policies aiming at increasing productivity in Ghanaian enterprises and, hence, long-run economic growth, should emphasize the training and education of the employees.

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Appendix A

Table A-1. Variable Definitions

Variable	Definition
Accra	1 if individual is working in a firm in Accra
Africa	1 if employee is African and zero otherwise
Age	age of an employee
Appr	1 if employee has been in an apprentice in the firm and zero otherwise
educom	completed level of education
Empl	number of employees in the firm
Europea	1 if employee is European and zero otherwise
Exportsh	export share in produced output
Female	1 if employee is a female and zero when a male
Food	1 if individual is working in the food sector
Foreigli	1 if firm holds foreign licenses
Found	1994 - year business was founded
Jobamd	1 if employee is currently doing administrative or clerical work
Jobcom	1 if employee is currently doing commercial/sales work, working in maintenance, or as a technician
jobman	1 if employee is currently working as a manager or supervisor/foreman
Jobprod	1 if employee is currently working as a production worker
jobprof	1 if employee is currently a professional (engineer, accountant, etc.)
Jobsupp	1 if employee is currently working as support staff
Kumasi	1 if individual is working in a firm in Kumasi
Married	1 if employee is married and zero otherwise
Metal	1 if individual is working in the metal sector
mid	1 if individual has completed middle school
Mowage	monthly wages
Mowork	number of months employed in the firm (tenure)
Non	1 if individual has no completed education
Numexpat	number of expatriates in the firm
Other	1 if individual is working in a firm in another location
Permem	1 if employee is permanent and zero otherwise
Pri	1 if individual has completed primary school
Proftech	1 if individual has completed technical/polytechnic or professional education
Sec	1 if individual has completed secondary school
Textile	1 if individual is working in the textile sector
Train	1 if employee has been trained inside the firm and zero otherwise
Training	1 if employee has been trained and zero otherwise
Trainou	1 if employee has been trained outside the firm and zero otherwise
Uni	1 if individual has completed university
Union	1 if employee is member of a labor union and zero otherwise
Valad	value added: total value of sales minus costs of raw material inputs and indirect costs (electricity etc.)
Voc	1 if individual has completed vocational education
Wood	1 if individual is working in the wood sector

Note: The prefix **l** indicates that it is the natural logarithm of a variable and **d** that it is a dummy variable which takes the value one or zero. The suffix **1** indicates it is the first wave of the RPED data and **sq** denotes that it is the square of the variable.

Variable	Interaction variables

Ageeuro	age* traiou
Agetrao	age*traiou
Ageunio	age*union
Apprmeta	appr*metal
Apprtext	appr*textile
Apprtrao	appr*traiou
Apprunio	appr*union
Apprvala	appr*lvalad
Apprwood	appr*wood
Educfe	female*educom
Empleuro	lempl*europea
Emplmeta	lempl*metal
Empltext	lempl*textile
Empltrao	lempl*traiou
Emplunio	lempl*union
Emplvala	lempl*lvalad
Emplwood	lempl*wood
Eurotrao	europea*traiou
Eurounio	europea*union
Expeuro	exportsh*europea
Expmeta	exportsh*metal
Exptext	exportsh*textile
Expunio	exportsh*union
Expvala	exportsh*lvalad
Expwood	exportsh*wood
Femtex	female*textile
Folieuro	foreigli*europea
Folimeta	foreigli*metal
Folitext	foreigli*textile
Foliunio	foreigli*union
Folivala	foreigli*lvalad
Foliwood	foreigli*wood
Foodexp	food*exportsh
Founeuro	found*europea
Founmeta	found*metal
Fountext	found*textile
Fountrao	found*dtraiou
Foununio	found*union
Founvala	found*lvalad
Founwood	found*wood
Metaeuro	metal*europea
Metalexp	metal*exportsh
Metatrao	metal*traiou
Metaunio	metal*union
Mowktrai	mowork*train
Nexpeuro	numexpat*europea
Nexpmeta	numexpat*metal
Nexptext	numexpat*textile
Nexptrao	numexpat*traiou
Nexpunio	numexpat*union
Nexpvala	numexpat*lvalad
Nexpwood	numexpat*wood
Permeuro	permem*europea
Permtrao	permem*traiou

Permunio	permem*union
Texteuro	textile*europea
Textiexp	textile*exportsh
Texttrao	textile*traiou
Textunio	textile*union
Unioeuro	union*europea
Uniometa	union*metal
Uniotext	union*textile
Uniotrao	union*traiou
Uniovala	union*lvalad
Uniowood	union*wood
Valaeuro	lvalad*europea
Valameta	lvalad*metal
Valatext	lvalad*textile
Valatrao	lvalad*traiou
Valaunio	lvalad*union
Valawood	lvalad*wood
Valfem	lvalad*female
Woodeuro	wood*europea
Woodexp	wood*exportsh
Woodtrao	wood*traiou
Woodunio	wood*union

Appendix B

Table B-1. Wages and Productivity

	Log value added				Log monthly wages			
Variable	Coefficient	Standard error	t-statistic	P>|t|	Coefficient	Standard error	t-statistic	P>|t|
Accra	0.856	0.205	4.174	0.000	0.167	0.068	2.454	0.015
Age	0.146	0.045	3.224	0.001	0.050	0.015	3.308	0.001
Age squared	-0.001	0.001	-2.030	0.043	-0.001	0.000	-2.482	0.013
Apprentice	-0.153	0.288	-0.529	0.597	-0.364	0.095	-3.811	0.000
Constant	10.248	0.872	11.757	0.000	8.991	0.289	31.162	0.000
Female	-0.408	0.240	-1.698	0.090	-0.155	0.079	-1.947	0.052
Manager	0.255	0.334	0.763	0.446	0.284	0.111	2.567	0.011
Middle school	1.552	0.316	4.907	0.000	0.344	0.105	3.289	0.001
Primary school	0.348	0.546	0.638	0.524	0.410	0.181	2.270	0.024
Secondary school	1.353	0.358	3.778	0.000	0.447	0.119	3.769	0.000
Support staff	-0.992	0.295	-3.367	0.001	-0.504	0.098	-5.172	0.000
Technical school	1.347	0.433	3.113	0.002	0.394	0.143	2.750	0.006
Training by outside providers	0.092	0.211	0.439	0.661	0.149	0.070	2.136	0.033
Union	2.087	0.232	9.015	0.000	0.146	0.077	1.911	0.057
University	2.028	0.818	2.480	0.014	1.052	0.271	3.885	0.000
Vocational school	0.820	0.299	2.746	0.006	0.180	0.099	1.818	0.070
Wood sector	-0.720	0.289	-2.496	0.013	-0.327	0.096	-3.426	0.001

Note: See appendix table A-1 for variable definitions.
Source: Author's calculations.

Table B2. Wages and Productivity Including a Continuous Variable for Education

	Log value added				Log monthly wages			
Variable	Coefficient	Standard error	t-statistic	P>|t|	Coefficient	Standard error	t-statistic	P>|t|
Accra	0.776	0.204	3.814	0.000	0.161	0.067	2.423	0.016
Age	0.161	0.046	3.540	0.000	0.046	0.015	3.083	0.002
Age squared	-0.001	0.001	-2.484	0.013	-0.001	0.000	-2.355	0.019
Apprentice	-0.086	0.291	-0.294	0.769	-0.367	0.095	-3.857	0.000
Completed level of education	0.434	0.069	6.318	0.000	0.137	0.022	6.077	0.000
Constant	9.632	1.015	9.486	0.000	8.587	0.332	25.835	0.000
Female	-0.542	0.237	-2.287	0.023	-0.182	0.077	-2.346	0.020
Manager	0.266	0.330	0.806	0.421	0.295	0.108	2.736	0.007
Permanent employee	0.415	0.689	0.602	0.548	0.425	0.226	1.882	0.061
Support staff	-0.851	0.295	-2.891	0.004	-0.504	0.096	-5.224	0.000
Training by outside providers	0.036	0.213	0.168	0.867	0.131	0.070	1.876	0.061
Union	2.234	0.229	9.758	0.000	0.146	0.075	1.945	0.053
Wood sector	-0.512	0.288	-1.778	0.076	-0.273	0.094	-2.894	0.004

Note: See appendix table A-1 for variable definitions.
Source: Author's calculations.

Table B3. Wages and Productivity Including Female Interaction Variables

	Log value added				Log monthly wages			
Variable	Coefficient	Standard error	t-statistic	P>|t|	Coefficient	Standard error	t-statistic	P>|t|
Accra	0.887	0.205	4.327	0.000	0.192	0.067	2.886	0.004
Age	0.157	0.045	3.484	0.001	0.055	0.015	3.784	0.000
Age squared	-0.001	0.001	-2.212	0.028	-0.001	0.000	-2.802	0.005
Apprentice	-0.104	0.289	-0.359	0.720	-0.358	0.094	-3.816	0.000
Constant	10.060	0.843	11.929	0.000	8.897	0.274	32.422	0.000
Female x age	-0.020	0.008	-2.585	0.010	-0.009	0.003	-3.526	0.000
Female x wood sector	0.700	0.717	0.977	0.329	0.882	0.233	3.784	0.000
Manager	0.218	0.334	0.655	0.513	0.268	0.109	2.467	0.014
Middle school	1.546	0.313	4.932	0.000	0.328	0.102	3.216	0.001
Primary school	0.336	0.542	0.621	0.535	0.400	0.176	2.265	0.024
Secondary school	1.371	0.358	3.834	0.000	0.437	0.116	3.752	0.000
Support staff	-1.028	0.294	-3.495	0.001	-0.516	0.096	-5.389	0.000
Technical school	1.366	0.431	3.169	0.002	0.400	0.140	2.852	0.005
Training by outside providers	0.060	0.210	0.283	0.777	0.127	0.068	1.861	0.063
Union	2.080	0.231	9.017	0.000	0.141	0.075	1.880	0.061
University	2.080	0.815	2.553	0.011	1.081	0.265	4.077	0.000
Vocational school	0.803	0.298	2.690	0.007	0.153	0.097	1.573	0.117
Wood sector	-0.864	0.316	-2.735	0.007	-0.494	0.103	-4.803	0.000

Note: See appendix table A-1 for variable definitions.
Source: Author's calculations.

Table B4. Wages and Productivity Including Unskilled Worker Interaction Variables

	Log value added				Log monthly wages			
Variable	Coefficient	Standard error	t-statistic	P>|t|	Coefficient	Standard error	t-statistic	P>|t|
Accra	0.851	0.205	4.159	0.000	0.178	0.067	2.652	0.008
Age	0.146	0.045	3.232	0.001	0.052	0.015	3.468	0.001
Age squared	-0.001	0.001	-2.034	0.043	-0.001	0	-2.603	0.010
Apprentice	-0.079	0.290	-0.271	0.786	-0.410	0.095	-4.308	0.000
Constant	10.251	0.869	11.791	0.000	8.952	0.286	31.347	0.000
Female	-0.504	0.241	-2.090	0.037	-0.117	0.079	-1.480	0.140
Manager	0.465	0.346	1.346	0.179	0.172	0.114	1.515	0.131
Middle school	1.371	0.334	4.107	0.000	0.462	0.110	4.217	0.000
Primary school	0.337	0.542	0.621	0.535	0.414	0.178	2.323	0.021
Secondary school	0.991	0.389	2.550	0.011	0.554	0.128	4.339	0.000
Support staff	-0.971	0.297	-3.273	0.001	-0.537	0.097	-5.509	0.000
Technical school	1.338	0.430	3.112	0.002	0.396	0.141	2.807	0.005
Training by outside providers	0.143	0.210	0.681	0.496	0.124	0.069	1.798	0.073
Union	2.115	0.230	9.185	0.000	0.137	0.076	1.810	0.071
University	2.147	0.818	2.625	0.009	1.046	0.269	3.891	0.000
Unskilled x middle school	0.383	0.263	1.460	0.145	-0.265	0.086	-3.069	0.002
Unskilled x secondary school	0.972	0.432	2.250	0.025	-0.277	0.142	-1.955	0.051
Vocational school	0.821	0.298	2.757	0.006	0.169	0.098	1.728	0.085
Wood sector	-0.772	0.287	-2.686	0.008	-0.305	0.094	-3.228	0.001

Note: See appendix table A-1 for variable definitions.
Source: Author's calculations.

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